ORDER

6820.12

PROJECT IMPLEMENTATION PLAN
FOR VHF OMNIDIRECTIONAL RANGE (VOR)
AND DISTANCE MEASURING EQUIPMENT (DME)

April 25, 1991

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

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RECORD OF CHANGES

DIRECTIVE NO. 6820.12

CHANGE TO BASIC	SUPPLEMENT			OPTIONAL	CHANGE TO BASIC	SUPPLEMENTS			OPTIONAL

FOREWORD

This order transmits the project implementation plan (PIP) for the VHF Omnidirectional Range (VOR)/Distance Measuring Equipment (DME) systems. It provides guidance and direction for the orderly implementation of VOR/DME at 70 sites. The procedures and responsibilities in this order were developed using current agency directives. This order establishes program management, project implementation, and defines responsibilities governing the activities of organizations. This order also identifies and describes specific events and activities to be accomplished in order to implement the VOR/DME systems.

Rodman Gill
Program Director for
Navigation and Landing

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CHAPTER 1. GENERAL

1. **PURPOSE**. This order presents overall guidance and direction for the orderly implementation of the VHF Omnidirectional Range (VOR) Distance Measuring Equipment (DME). The purpose of this project implementation plan (PIP) is to set forth FAA management direction and the technical approach for implementing the VOR/DME portion of the National Airspace System (NAS). This order has been coordinated with cognizant FAA headquarters organizations and with regional offices. It will be used by the project office, in the office of the Program Director for Navigation and Landing (ANN), to provide general guidance to all parties having responsibilities in this implementation and it will be updated periodically to reflect current status as progress occurs.

2. **DISTRIBUTION**. This order is being distributed to branch level in the offices of the Program Directors for Navigation and Landing and Automation, and Training and Higher Education, the Systems Maintenance, NAS Transition and Implementation, Air Traffic Plans and Requirements, Flight Standards, and the Logistics Services; branch level to the FAA Logistics Center at the Aeronautical Center; director level at the FAA Technical Center; branch level to the regional Airway Facilities, Air Traffic, and Flight Standards divisions; and a limited distribution to all Airway Facilities field offices.

3. **AUTHORITY TO CHANGE THIS ORDER**. This order may only be changed by the Program Director for Navigation and Landing. Requests for changes to this document should be directed to the Manager, Navigation and Landing Engineering Division, ANN-100, FAA Headquarters, 800 Independence Avenue, S.W., Washington, DC 20591.

4.-19. **RESERVED**.

CHAPTER 2. PROJECT OVERVIEW

20. SYNOPSIS. The VOR/DME Program is an element of the Capital Investment Plan (CIP) to expand the en route navigation capability to satisfy new operational requirements that have arisen in various geographic areas and are required to improve the air route structure for more efficient movement of air traffic into and around major hub airports. The current program entails the initial contract award for a firm quantity of 40 VOR/DME systems with options for an additional 30 systems and 30 Doppler VOR conversion kits to be exercised when funding becomes available. The equipment specification requires that these systems will be fully compliant with Interface Control Document (ICD) NAS-MD-790, Remote Maintenance Monitoring Interface Control Document, and will interface directly with the maintenance processor subsystem (MPS).

21. PURPOSE. VOR/DME is the national and international standard for providing distance and azimuth en route navigation signals to properly equipped aircraft operating in the NAS as well as in international airspace. The radiated signals from the VOR/DME provide the aircraft with distance and bearing information to the VOR/DME facility.

22. HISTORY. From 1982 through 1989, the FAA replaced 950 vacuum-tube type VOR and VOR/TACAN (VORTAC) systems with solid-state equipment which has embedded remote maintenance monitoring (RMM) and control capabilities. The RMM associated with this equipment is not compatible with the requirements of NAS-MD-790 and thus is not able to interface directly with the MPS at the Air Route Traffic Control Center (ARTCC). It was initially determined that due to the large existing number of systems (950), that the new procurement should require compatibility between the new systems and the existing FA-9996 second generation VOR-VORTAC systems. When this concept was advertised to industry, it became immediately apparent that protests, with substantial merit, based on the competitive advantage of the previous manufacturer/s of the second generation systems would be rendered that would seriously jeopardize the program schedule. The decision was then made to revise the equipment specification to create a wholly competitive situation by requiring a system that included a remote monitoring subsystem (RMS) function that is totally NAS-MD-790 compliant. The specification was revised to delete the compatibility requirement and a request for proposals (RFP) was released on September 21, 1989, and a contract was awarded to Wilcox Electric, Inc., on September 28, 1990.

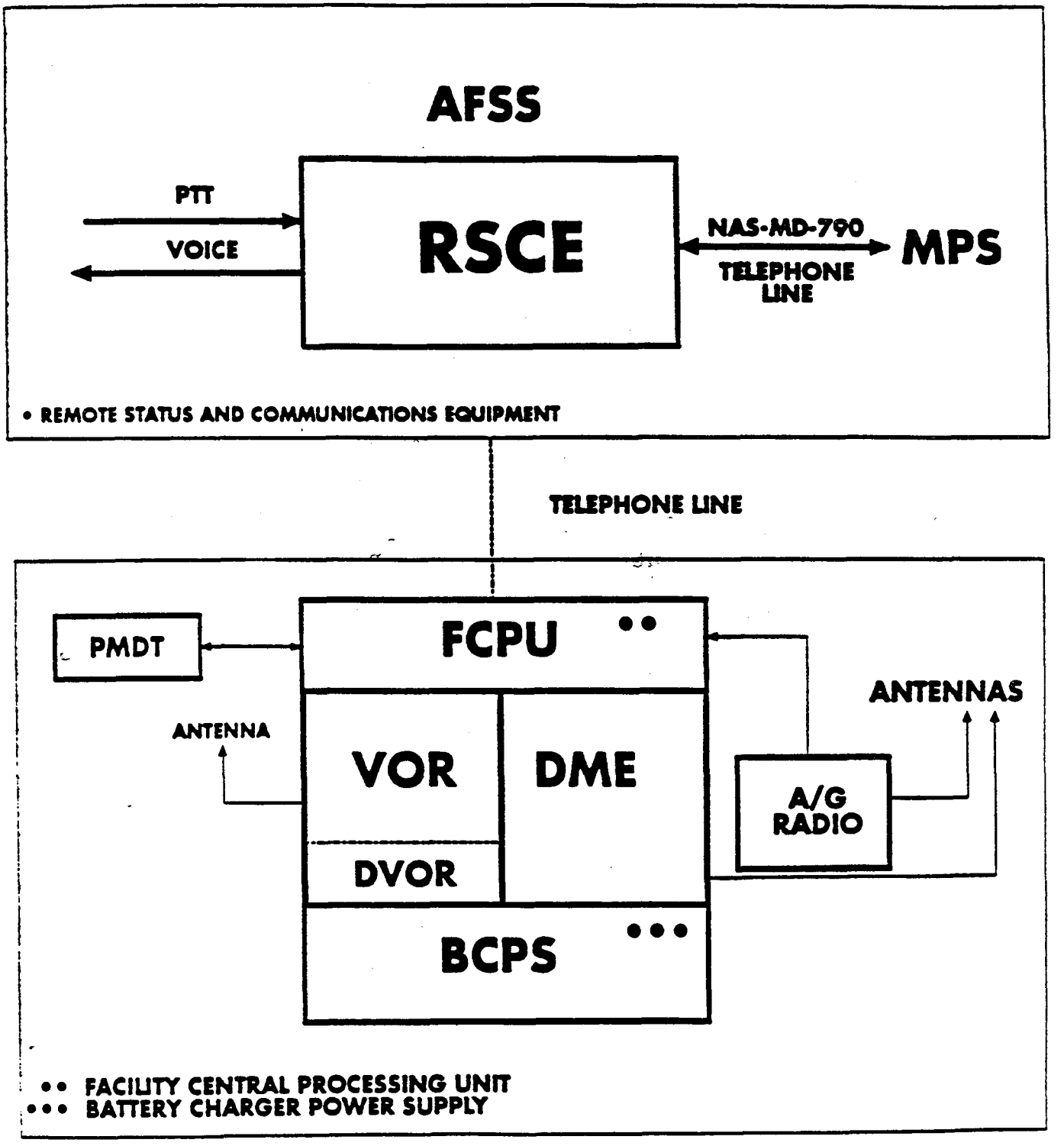
23.-29. RESERVED.

CHAPTER 3. PROJECT DESCRIPTION

30. FUNCTIONAL DESCRIPTION. The functional relationships of the major VOR/DME units are shown in figure 3-1. The facility central processing unit (FCPU) and battery charger power supply (BCPS) are indicated as shared units between the VOR and the DME as they indeed are; however, they are integral units of the VOR. The VOR broadcasts an omnidirectional signal containing fixed reference phase and variable phase signal components that vary in phase relationship (0 to 360 degrees) to each other as a direct function of the azimuthal position of the aircraft receiving antenna with respect to the facility. The aircraft receiver compares the phase relationship of the component signals and provides the variation in phase to the cockpit deviation indicator (CDI) as the azimuth bearing to the facility. The VOR azimuth information is accurate to within ± 1.3 degrees as verified by flight inspection. The VOR also provides a 1020 Hz Morse code identification signal alternating with a voice identification signal. The identification signal is removed when the VOR is shut down for maintenance or is otherwise out of service. The DME receives pulse coded interrogation signals of the correct frequency and spacing from the aircraft and after a fixed reply time delay (50 u sec), transmits reply pulses of the proper frequency and pulse pair spacing. The aircraft receiver measures the round-trip transit time from interrogation to receipt of the reply pulses (compensating for the fixed reply delay) and converts the time interval to slant range distance in nautical miles for readout on the cockpit instrument display panel. Additionally, the DME receives a timing identification signal from the VOR and transmits one 1350 Hz Morse code identification cycle following every three VOR identification cycles. The DME distance information is accurate to within ± 0.5 nautical miles or ± 3.0 percent of the distance, whichever is greater. The VOR/DME system includes the units shown in figure 3-1. These units are described in the following subparagraphs.

a. VOR Transmitter. The VOR transmitter operates in the frequency range of 108 to 118 mHz with 50 kHz spacing between channels. The transmitter provides at least 150 watts of carrier power to the antennas. The transmitter carrier output is amplitude modulated by: (1) 9960 Hz ± 480 Hz, which when detected by the frequency discriminator circuit in the aircraft receiver, produces the 30 Hz fixed phase reference signal, (2) voice signals of 300 through 3000 Hz, and (3) 1020 Hz identification signal.

FIGURE 3-1. VOR/DME FACILITY



The transmitter includes the goniometer assembly used (1) to generate the 9960 Hz frequency modulated (FM) subcarrier signal which is used to amplitude modulate the carrier and (2) to produce two radio-frequency (RF) double sideband suppressed carrier outputs which are 30 Hz removed (30 Hz above and below) from the carrier signal. The sideband signals are fed to the four alford loop antenna array and when detected and demodulated, produce the 30 Hz variable signal. Additionally, the transmitter includes the identification oscillator/keyer unit.

b. VOR Monitor. The VOR monitor receives an input signal from one of the 16 monitor antennas which are mounted on the periphery of the VOR counterpoise. The signal is fed to the monitor through the ground check switch which provides the capability of using independent signals from all of the monitor antennas for purposes of conducting a complete 16 point automatic ground check of the VOR. The automatic ground check is completely software/firmware controlled and is conducted not less than once every 15 minutes. The monitor contains built-in test equipment (BITE) which enables it to verify the accuracy of the VOR radiated signal against internal standards. The monitor shall detect faults and initiate alarm action if any of the following parameters are outside of tolerance:

(1) Azimuth.

(2) FM subcarrier modulation percent.

(3) 30 Hz reference (AM) modulation percent.

(4) FM subcarrier frequency deviation.

(5) Identification code.

(6) Field intensity.

The monitor alarm control circuit is such that both monitors must indicate an alarm prior to initiation of alarm and shutdown action. If the alarm results in shutdown of the VOR, there is an auto-reset circuit which will attempt three times to reset the system and continue normal operation if there are no more than three alarms within any 15-minute period. If a fourth alarm occurs during any 15-minute period, no further auto-resets are attempted. The time intervals for auto-resets are established at 20 seconds, 32 seconds, and 105 seconds following the initial alarm, assuming that none of the reset attempts are successful.

c. Facility Central Processing Unit (FCPU). The VOR FCPU provides the RMS functions for the VOR/DME as defined in ICD NAS-MD-790, NAS-MD-792, Operational Requirements for the Remote Maintenance Monitoring System (RMMS), and NAS-MD-793, Remote Maintenance Monitoring System Functional Requirements for the Remote Monitoring Subsystem (RMS). It provides local and remote adjustment, testing, and control capabilities of the VOR/DME equipment through appropriate equipment and external interfaces. Additionally, it manages voice and data communications between the VOR/DME equipment units and the remote status communications equipment (RSCE) and data communications between the VOR/DME equipment and the MPS.

d. Battery Charger Power Supply (BCPS). The BCPS receives its primary power from a nominal 120/240 volt, 60 Hz, three-wire, single phase alternating current (AC) power source. The BCPS provides all of the direct current (DC) power required for operation of the VOR and DME equipment and that which is required to charge and provide equalize and float voltage to the Government furnished battery bank. The power required for the DME final amplifier is permitted to be derived from the primary AC power. In the event of a failure of the primary AC power, the BCPS provides the DC voltages from the battery bank and an alternate source of AC power from the batteries through a DC to AC inverter.

e. DME Transponder/Receiver Unit. The transponder/receiver operates on two discrete, paired frequencies in the range of 962 to 1213 mHz. It contains the circuitry to receive and decode interrogation signal pulses and in response thereto, radiate a properly coded reply pulse pair after a specific reply delay time. The transponder will also produce and radiate random pulse pairs sufficient in number to maintain a minimum output pulse count of 1350 $\pm$ 150 pulse pairs. Additionally, the transponder will produce and radiate International Morse Code identification signals in response to a timing signal from the VOR. The unit contains a duplexer which permits simultaneous operation of the receiver and transponder on a single antenna. The transponder is capable of being set up for two different peak power levels of 1000 watts or 100 watts depending on the facility requirements.

f. DME Monitor. The monitor is designed to provide full-full-time, automatic monitoring of the transponder/receiver unit through the use of BITE. It contains an internal interrogation signal generator which in addition to producing on-channel interrogation pulse pairs, produces pulse pair outputs for test purposes of $\pm$ 200 Hz and $\pm$ 900 Hz from the on-channel frequency.

The BITE within the monitor shall be used for normal monitoring of the operating transponder and receiver and to provide testing for alarm limit certification upon command from the FCPU. The monitor will verify correctness and initiate alarm action if any of the following parameters are outside of tolerance:

(1) Reply delay.

(2) Output pulse spacing.

(3) Receiver sensitivity.

(4) Transponder output pulse rate.

(5) Transponder power output.

(6) Identification.

(7) Radiated power level.

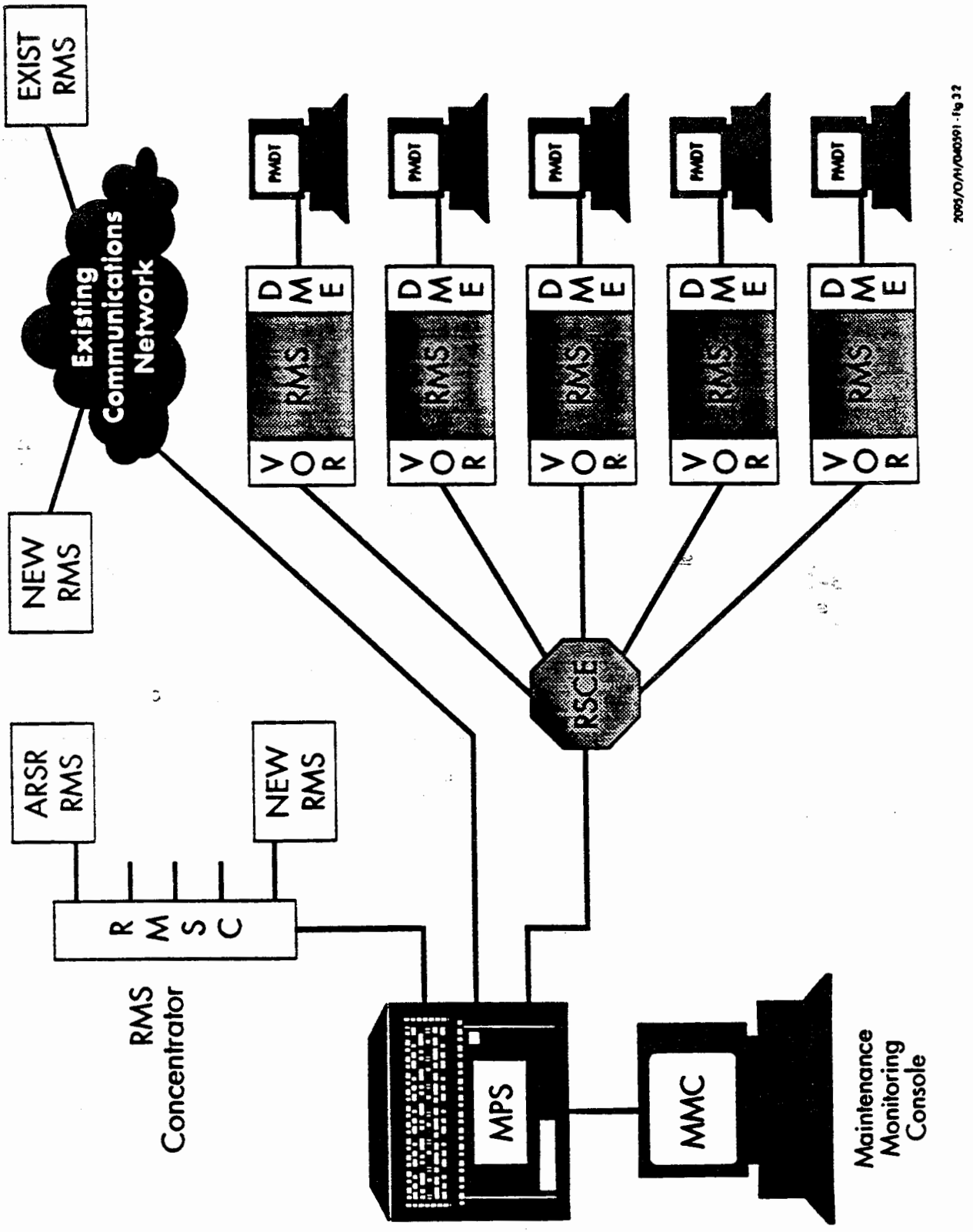
The DME control circuitry is the same as the VOR in that it requires both monitors to be in alarm before alarm and shutdown action is initiated. The DME also contains the automatic reset circuitry described under paragraph 31b for the VOR monitor.

g. Remote Status and Communications Equipment (RSCE). See figure 3-2. The RSCE is located at the local automated flight service station (AFSS) and is used to provide VOR/DME operational status information and two-way audio communications capability to the AFSS operations personnel. It additionally provides a data interface between the VOR/DME facility and the MPS at the controlling ARTCC. The RSCE includes the following equipment subassemblies:

(1) Communications units. The communications unit provides two-way voice communications between the VOR facility and the AFSS. It enables the flight service specialist to voice modulate the VOR transmitter by the use of a push-to-talk signal to the VOR which removes the VOR voice identification signal and replaces it with that of the specialist. It also provides the signal path of the remote communications outlet (RCO) receiver voice from the VOR site to the AFSS operations room speakers.

(2) RSCE processing unit. The RSCE processing unit separates the VOR/DME operational status information from the data being transmitted to the MPS and provides the status information to the VOR/DME status unit. The unit will also provide buffer and processing action in collecting input data at

FIGURE 3-2. RMMS BASIC CONFIGURATION



differing rates from the VOR/DME FCPU and the MPS and will buffer the received data to a higher or lower rate as appropriate.

(3) VOR/DME status unit. The VOR/DME status unit will be installed in a console in the AFSS operations room that may be remoted up to 200 feet from the RSCE. The status unit will provide the following functions:

(a) Visual indication of the status of the VOR and DME systems by the use of red ALARM and green NORMAL lights.

(b) Visual indication of the monitor in BY PASS.

(c) An aural indication of a VOR or DME alarm.

(d) A momentary aural alarm silence switch.

(e) A momentary push button to test the operability of all lamps.

31. PHYSICAL DESCRIPTION. The VOR/DME equipment will be housed in not more than three aluminum or steel cabinets designated to be installed inside a Government furnished shelter. The cabinets will include a grounding-type convenience outlet mounted on the bottom front of the cabinet. The cabinets will have two top openings with removable cover plates for cable entrance and egress. The openings will be designed to accommodate standard two and one-half inch electrical metallic tubing (EMT) to be furnished by the Government. The cabinets are designed to provide maximum accessibility to all units, modules, assemblies or subassemblies from the front, side, top, or rear of the cabinet by the use of swing-out or pull-out chassis, pull-out drawers, hinged cabinet or equivalent means. Major assemblies or units will be designed for complete removal from the cabinet without disassembly. Cable retractors and circuit extenders will be provided for module operation in the open position. A circuit board extractor or circuit board handles will be provided for ease in removal of circuit boards from their connectors. The extender boards or cables are intended for the accomplishment of detailed trouble shooting only. Normal functional checks of the equipment can be made through the provision of significant test points which are readily accessible to allow testing without interruption of operation. All of the VOR/DME adjustments required for operation and maintenance and all indications resulting from such adjustment will be accessible locally via the FCPU to portable maintenance data terminal (PMDT) interface or remotely from the MPS. The PMDT interface will be available on the front panel of the equipment cabinet containing the FCPU. The RSCE, located in the AFSS equipment room, is designed for

installation in a standard 19-inch cabinet rack. The equipment is chassis mounted on a rack panel and requires an E panel (8 23/32" high) space in an existing equipment rack. The input and output connections are on the rear of the chassis. The VOR/DME status unit is to be installed in an existing operations console in the AFSS operations room. The status unit is a panel mounted chassis with removable rear cover designed to be mounted on the console within a rectangular cut-out no more than 3 inches wide and 5 inches high. Facilities for connecting the status unit to the RSCE are provided by a recessed male connector on the rear of the chassis. The status unit receives its operating power requirements through the RSCE interconnecting cable.

32. SYSTEM REQUIREMENTS. The VOR/DME requirements include power, siting, shelter, and operational needs. System reliability and maintainability are design requirements of the equipment specification and will be demonstrated prior to full field deployment.

a. Power. The VOR/DME system operates from a nominal 120/240 volt, 60 Hz, three-wire, single phase AC power source. The input power requirements are conservatively estimated to be less than 2500 watts. The commercial power system will be supported with a Government furnished back-up battery bank designed to provide uninterruptable power for a minimum of 4 hours in the event of failure of the primary power. Upon restoration of the primary power, the batteries will be recharged from a 50 percent discharge state to full charge in less than 24 hours. Electrical work will be in accordance with specification FAA-C-1217e.

b. Siting. The siting of a VOR/DME facility is a very complex procedure and must include aspects in addition to the electromagnetic propagation of the VOR/DME signals. The siting requirements for VOR are somewhat more stringent than those of the DME and will usually determine the final site selection. In addition to the basic requirement for a relatively flat or downward sloping surface extending outward in all directions from the VOR site that is devoid of natural or man-made reflecting surfaces, consideration must also be given to the site acquisition costs, proximity of an acceptable primary power source, results of environmental impact studies and other such factors. A complete coverage of the VOR/DME siting requirements is presented in Order 6820.10, VOR, VOR/DME and VORTAC Siting Criteria, that must be used for this purpose.

c. Shelter. The VOR/DME equipment shelter is to be furnished by the Government. The regional Airway Facilities division will be responsible for providing the shelters which

will be made available from a Washington office open-ended requirements contract. The shelter contractor will be responsible for erecting the shelter and counterpoise on the foundations provided by the Government's site construction contractor. New construction utilizing the Washington office standard shelters will be required for the establish projects whereas the existing shelters may be reused for the replacement projects if the responsible region determines that the shelter is fully acceptable. The Air Traffic Control Tower/Facilities Program, ANS-240, is in the process of preparing a national standard for the VOR/DME equipment shelters that will be used for all new shelters. The standard is expected to be published no later than the end of May 1991.

d. Operational Needs. In order to interface the VOR/DME site with the AFSS and thence to the MPS location, a Government furnished dedicated four-wire telephone line must be provided. The telephone lines will be private line, data voice-grade circuits that will be unity gain and will be furnished with OdB transmission level point (TLP) at the send and receive interface. The contractor is to deliver the ICD in accordance with NAS-MD-790 within 12 months after contract award. The ICD will define all pertinent information required to interface the VOR/DME RMS with the MPS. After the ICD has been validated and before field deployment of the VOR/DME systems, the interim monitor and control software (IMCS) program needs to be loaded into the MPS. Without an operational VOR/DME IMCS program residing in the MPS, remote monitor and control functions will not be operational.

e. Electromagnetic Interference. Conducted emission, conducted susceptibility, radiated emission, and radiated susceptibility levels on incoming AC power leads, interconnecting leads, radiated signals, antenna leads and control lines, as applicable, shall not exceed the limits defined in MIL-STD-461, Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference, as specified in the equipment specification, FAA-E-2678C VOR/DME Equipment Specification.

f. Reliability. The VOR/DME equipment reliability criteria are depicted below.

Equipment	Mean Time Between Failures (MTBF)
VOR	7,500 Hours
DME	5,000 Hours
RSCE	20,000 Hours

g. Maintainability. The VOR/DME mean time to repair (MTTR) shall be equal to or less than 30 minutes. The specified repair time shall include diagnostic time, removal of the failed line

replaceable unit (LRU), replacement, and installation of the new LRU including any adjustments or data loading necessary to initialize the LRU and all adjustments required to return the VOR/DME to normal operation.

33. INTERFACES. The following interfaces are required for the VOR/DME system.

a. FCPU to RSCE. The FCPU to RSCE interface is in accordance with EIA standard RS-232, wired as synchronous data terminal equipment (DTE). It will interface through a contractor furnished commercially available voice over data modem system with the Government furnished four-wire telephone line and will operate at a minimum rate of 1200 baud. This interface will be fully compatible with NAS-MD-790.

b. FCPU to PMDT. The FCPU to the PMDT interface is in accordance with EIA standard RS-232, wired as asynchronous data communications equipment (DCE). The PMDT interface will automatically adjust to baud rates of 2400, 4800, and 9600.

c. RSCE to MPS. The RSCE to MPS interface is in accordance with EIA standard RS-232, wired as synchronous data equipment. It will interface through a Government furnished commercially available data modem to the Government furnished four-wire telephone line. The data rate on this interface will automatically adjust to baud rates of 2400, 4800, and 9600. The interface will be fully compliant with NAS-MD-790.

d. RSCE to FCPU. The RSCE to FCPU interface shall be identical to the FCPU to RSCE addressed in paragraph 33a.

e. RSCE to Communications Unit (CU). An interface will be provided by the contractor for the transfer of status data and voice communications between these two units.

f. CU to AFSS Operations Room. A multi-pair audio cable will be provided by the Government to interface the CU to the VOR/DME status unit and the AFSS operations room console for two-way voice communications and for application of the VOR push-to-talk signal. The interconnect cable and connector types will be specified by the contractor.

34.-39. RESERVED.

CHAPTER 4. PROJECT SCHEDULE AND STATUS

40. PROJECT SCHEDULES AND GENERAL STATUS. The VOR/DME program is a multiyear funded effort. The FY-89 and FY-90 funding was sufficient to accommodate an initial award for a firm quantity of 40 VOR/DME systems and to exercise one of three options for 10 additional VOR/DME systems, the training option and the option for 30 each Doppler VOR conversion kits. It is planned that the final two options for 20 systems will be exercised using FY-92 funds (assuming they are approved by Congress).

41. MILESTONE SCHEDULE SUMMARY. The current project schedule is shown in Table 4-1, VOR/DME Schedule. Project events are scheduled in relationship to the date of contract award. This table is not meant to be an all inclusive listing of all project milestones necessary for project completion but it does include the very major project requirements.

42. INTERDEPENDENCIES AND SEQUENCE. The total operational capability of the VOR/DME is dependent upon the loading of the IMCS program into the MPS at each of the controlling ARTCC locations as previously discussed in paragraph 32d. The ICD required for this application is contractually scheduled for delivery 12 months after contract award; assuming that validation and acceptance of the ICD is completed in a reasonable period of time, programming of the IMCS should be completed in sufficient time to satisfy program requirements. The VOR/DME program is not dependent on any other programs.

43.-49. RESERVED.

ACTIVITY/MILESTONE	CURRENT SCHEDULE
Contract Award	9/90
Master Test Plan (MTP) Approval	10/90
Project Implementation Plan (PIP) Approval	10/90
Post Award Conference	10/90
System Design Review	2/91
Contractor MTP	4/91
Preliminary Design Review	5/91
Initiate Deployment Readiness Review (DRR) Process	5/91
Convene DRR Team Meeting	7/91
Critical Design Review (CDR)	9/91
Interface Control Documentation (ICD)	9/91
Final Software Test Descriptions	11/91
Instruction Book Draft Manuscript	1/92
Final Hardware Test Procedures	5/92
Commence Factory Tests	6/92
Exercise Contract Option for 20 Additional Systems	6/92
Ship First Article to FAA Technical Center	8/92
Conduct Production Acceptance Test and Evaluation - Site Acceptance Test (PAT&E-SAT) at FAA Technical Center	9/92
Conduct Integration Test/System Level Test and Evaluation (IT/SLT&E)	10/92
Conduct Shakedown Test and Evaluation (ST&E)	11/92
Submit DRR Report	12/92
Deployment Decision	1/93
First Site Delivery	1/93
Conduct Joint Acceptance Inspection (JAI)	2/93
First Operational Readiness Demonstration (ORD) and Commission	3/93
Deliver 6 Production Systems Per Month	

CHAPTER 5. PROJECT MANAGEMENT

50. PROJECT MANAGEMENT, GENERAL. This chapter describes the organizations within the Office of the Associate Administrator for NAS Development (AND) that are directly responsible for the VOR/DME program management.

a. Associate Administrator. The Associate Administrator's office manages, directs, and executes the FAA's engineering and management activities related to facilities design, air navigation, landing aids, and air traffic control facilities and equipment to ensure that the NAS is efficient, economical, and responsive to operational needs.

b. Navigation and Landing Program (ANN-1). This organization is the principal element within the Office of the Associate Administrator responsible for the development and implementation of systems, programs and facilities requirements for navigation and landing systems.

c. Navigation Program (ANN-300). This organization is the principal element of ANN-1 responsible for design, development and implementation responsibilities for all aids to navigation.

d. VOR/DME Program. The VOR/DME project manager is supported by the matrix organization and is responsible for the management of the VOR/DME program from inception to facility commissioning. The project manager's responsibilities include:

(1) Management. Planning, scheduling, and managing the program from budget submission to development of procurement documentation through contract award, system deployment, and commissioning.

(2) Logistics Support. Provides, in conjunction with the National Airspace Integrated Logistics Support (NAILS) Management Team (NAILSMT), technical guidance to define logistic support requirements, including provisioning, training and documentation, for the support of the VOR/DME program.

(3) Technical Officer. Providing engineering support, advice, and consultation to the contracting officer during procurement and contract management.

(4) Cost Data. Developing and providing cost data, controlling assigned funds, and adjusting program schedules, requirements, and objectives as required to complete the program.

(5) Testing. Takes the lead in the review, coordination,

and approval of the contractor's proposed testing program. Coordinates with other responsible organizations in the development, reviews, and approval of test procedures designed to demonstrate total NAS deployment acceptability of the VOR/DME systems.

51. **PROJECT CONTACTS.** This paragraph lists VOR/DME project contacts and their routing symbols and telephone numbers.

a. Program Director. Rodman Gill, ANN-1, FTS-267-6531.

b. Program Manager. Charles Ochoa, ANN-300, FTS-267-6600.

c. Project Manager. Charles Beam, ANN-130, FTS-267-6589.

52. **PROJECT COORDINATION.** The VOR/DME program requires coordination with other Washington office organizations, with regional airway facilities and logistics personnel, and with the prime contractor. Coordination with the organizations listed in the following subparagraphs is essential for proper management of the VOR/DME program.

a. Maintenance Engineering Division (ASM-100). ASM-100 reviews procurement specifications to ensure the design meets the reliability and maintainability requirements and supports the general maintenance philosophy. ASM-100 also develops maintenance standards and plans for implementation of maintenance concepts.

b. Maintenance Operations Division (ASM-200). ASM-200 participates in the development and review of maintenance plans. In addition, ASM-200 develops national Airway Facilities sector staffing standards for the VOR/DME program and validates maintenance staffing requirements. The program manager ensures the project is in conformance with staffing, training, certification policies, guidelines, and requirements.

c. Telecommunications Management and Operations Division ASM-300. ASM-300 is responsible for the overall management of FAA telecommunications, both national and regional. They determine the general networking approach to satisfy all telecommunications needs and coordinate with regional TM&O organizations to implement the required networks or circuits.

d. Spectrum Engineering Division (ASM-500). ASM-500 obtains frequency authorization necessary to satisfy the requirements of the NAS. The division also provides engineering support to regional and field facilities in the resolution and prevention of RF interference to NAS facilities.

e. National Engineering Field Support Division (ASM-600). ASM-600 prepares the ST&E requirements and test plans and conducts the ST&E on the first VOR/DME system. After system deployment, they are responsible for national documentation, equipment instruction book changes, equipment modifications, and field engineering support.

f. NAS Support Division (ALG-200). ALG-200 develops, recommends, and issues agency procedures, standards, and policies for material supply and management and disposal of personal property, and acquisition, management, and disposal of real property.

g. Contracts Division (ALG-300). ALG-300 performs cost/price analyses of contractor's proposals and participates as member of the Source Evaluation Board. In addition, ALG-300 provides procurement support for the VOR/DME by planning, placing, and administering contracts for the VOR/DME equipment. ALG-300 also designates a contracting officer (CO) who is responsible for all contractual matters. The CO is the only individual authorized to approve contract changes impacting price, delivery, or schedule.

h. Industrial Division (ALG-400). ALG-400 performs factory inspection of the VOR/DME equipment. ALG-400 assigns a quality reliability officer (QRO) at the time the contract is awarded. The QRO is the FAA representative at the contractor's facility and is responsible for verifying quality control. The QRO is directed by FAA policy and procedure, and by the terms and conditions of the contract.

i. FAA Academy (AAC-900). AAC-900 provides maintenance training and coordinates with ASM-200 in the development of a training plan.

j. Technical Training Division (AHT-400). AHT-400 analyzes training proposals prepared by ASM-200 and initiates action to meet training requirements.

k. FAA Aviation Standards National Field Office. The FAA Aviation Standards National Field Office is responsible for conducting flight inspections of VOR/DME systems needed to accomplish the following functions.

(1) Determining if the operational status of a facility or system is in accordance with the established tolerances.

(2) Certifying the facility or system for operational use in the NAS when all operational requirements have been met.

(3) When applicable, ensuring that required Notices to Airmen (NOTAMS) are issued for any facility or system restriction.

l. Maintenance Processors Software Branch (ANA-120). ANA-120 has the responsibility to develop a VOR/DME RMS IMCS module.

m. Nails Program Division (ANS-400). ANS-400 coordinates the development of an integrated logistics support plan for the VOR/DME acquisition.

n. FAA Logistics Center (AAC-400). AAC-400 is responsible for providing spares inventory, FAA Logistics Center level repair, input and project coordination for support requirements such as provisional technical documentation and engineering drawings. They are responsible for timely coordination of excessing property and phaseout supply support from excess if needed.

o. FAA Regional Offices. The FAA regional offices, through established administrative structures, coordinate with all responsible parties to assure adequate funding, establish system commissioning/service availability dates, assign project field representatives and determine utility availability for the VOR/DME system. The regions also provide field engineering as required to support preparations for the installation of the VOR/DME equipment; order Government Furnished Material (GFM) for tools and test instruments to support the VOR/DME installation and acceptance; tailor installation drawings to be site specific; initiate work orders and travel authorization; and assign field personnel. The following regional offices are responsible for the coordination required to accomplish the functions listed in subparagraphs 52 (1) and (2).

(1) Regional Airway Facilities Division.

(a) Installing facilities systems and equipment in accordance with established standards, specifications, and instructions.

(b) Notifying the appropriate sector that a project has been funded and issuing a projected implementation schedule.

(c) Provide advance notification to the Logistics division of pending real estate site requirements, construction contract requirements, and real property requirements. Site acquisitions and construction contracts are often lengthy and laborious tasks requiring a substantial amount of time.

(d) Providing the sector an opportunity to review and participate in project plans during the engineering phase and for furnishing the sector a copy of the engineering plans and contract documents.

(e) Providing the sector a copy of the project work order at least 10 days before the start of project work.

(f) Providing the appropriate facility reference data file (FRDF) information to the sector for inclusion in the FRDF. These data requirements will be established by the National Engineering Field Support Division, ASM-600, as part of ST&E.

(g) Notifying the joint acceptance board chairman of when the facility will be ready for JAI, providing the sector all data necessary to prepare warranty failure reports on items failing prior to JAI, and providing regional Airway Facilities division representatives for participation in the JAI.

(h) Establishing and maintaining a follow-up file for monitoring and clearing all JAI report exceptions, reviewing all JAI reports and follow-up reports for correctness, completeness, and proper distribution, taking appropriate and timely actions to clear JAI report exceptions, and identifying additional sources of funds or initiating budgetary action, as necessary, to clear exceptions.

(2) Airway Facilities Sector.

(a) Reviewing contract documents and engineering plans during the engineering phase and providing comments to the regional Airway Facilities division.

(b) Providing personnel as required at appropriate times throughout the project to witness and/or participate in construction, installation, tune-up, tests, and collection of technical reference data.

(c) Providing a representative to serve as the joint acceptance board chairperson and other qualified personnel for participation in the JAI, preparing and distributing the JAI report, and assuming maintenance responsibilities and

custodianship for facilities, systems, or equipment at the conclusion of JAI.

(d) Coordination and follow-up on exceptions after the JAI to include exceptions assigned to other organizations or to a contractor for clearance, clearing exceptions which have been assigned to the sector, reporting the clearance of exceptions, and reviewing all waived exceptions to determine if actions will impact sector operations or other organizations.

(e) Maintaining all equipment warranty information and reporting equipment failing under warranty.

(f) Receiving, storing, and shipping project materials and disposing of excess equipment and materials.

53. PROJECT RESPONSIBILITY MATRIX. Figure 5-1, Project Responsibility Matrix, illustrates the FAA organizations responsible for the implementation of each significant function of the VOR/DME project.

54. PROJECT MANAGERIAL COMMUNICATIONS. The VOR/DME project manager within ANN-130 is the focal point of all internal project communications. Organizations supporting the VOR/DME program will designate a representative to maintain communications with the Navigation APME, ANN-130, and the VOR/DME project manager. Supporting organizations maintain communications within the FAA but never directly with the contractor without the prior permission of the CO. The meetings listed in subparagraphs 54a- 54d are the regularly scheduled project meetings.

a. The National Airspace Integrated Logistics Support (NAILS) Management Team Meeting. These meetings are held to ensure that there is an interrelated, unified, and iterative approach to the managerial and technical activities which support the NAS. During these meetings, issues affecting logistics management, maintenance planning, supply support, test and support equipment, manpower and training support, support facilities, technical data, and packing, handling, storage and transportation are discussed and resolved. These meetings can be held at the FAA headquarters, FAA Logistics Center, or at the contractor's facility on a semiannual basis.

b. Program/Project Status Review Board Meetings. These meetings are held on a monthly basis at FAA headquarters to discuss project status and to resolve problems and issues

effecting all phases of the project. These meetings will commence at time of contract award and will continue until system deployment has been completed.

c. Program Overview Meetings (POM). The contractor shall conduct quarterly POM's at the contractor's facility beginning at the post award conference and ending at acceptance of the final system under contract. The purpose of the POM's shall be for the contractor to present a detailed contract status, to track outstanding action items, review potential and actual technical and programmatic problem areas and to evaluate performance with respect to program milestones presented in the Program Management Plan.

d. Technical Interchange Meetings (TIM). The Government may request a monthly TIM between the contractor and the technical officer or designated representatives. The purpose of these TIM's is to surface, discuss, and resolve through mutual agreement any technical, schedule, or programmatic issues associated with the VOR/DME contract.

55. IMPLEMENTATION STAFFING. There are no personnel requirements peculiar to the implementation phase of the VOR/DME project.

56. PLANNING AND REPORTS. None required.

57. APPLICABLE DOCUMENTS. The following documents have been referenced within this order.

a. FAA-E-2678c, VOR/DME Equipment Specification, August 7, 1989.

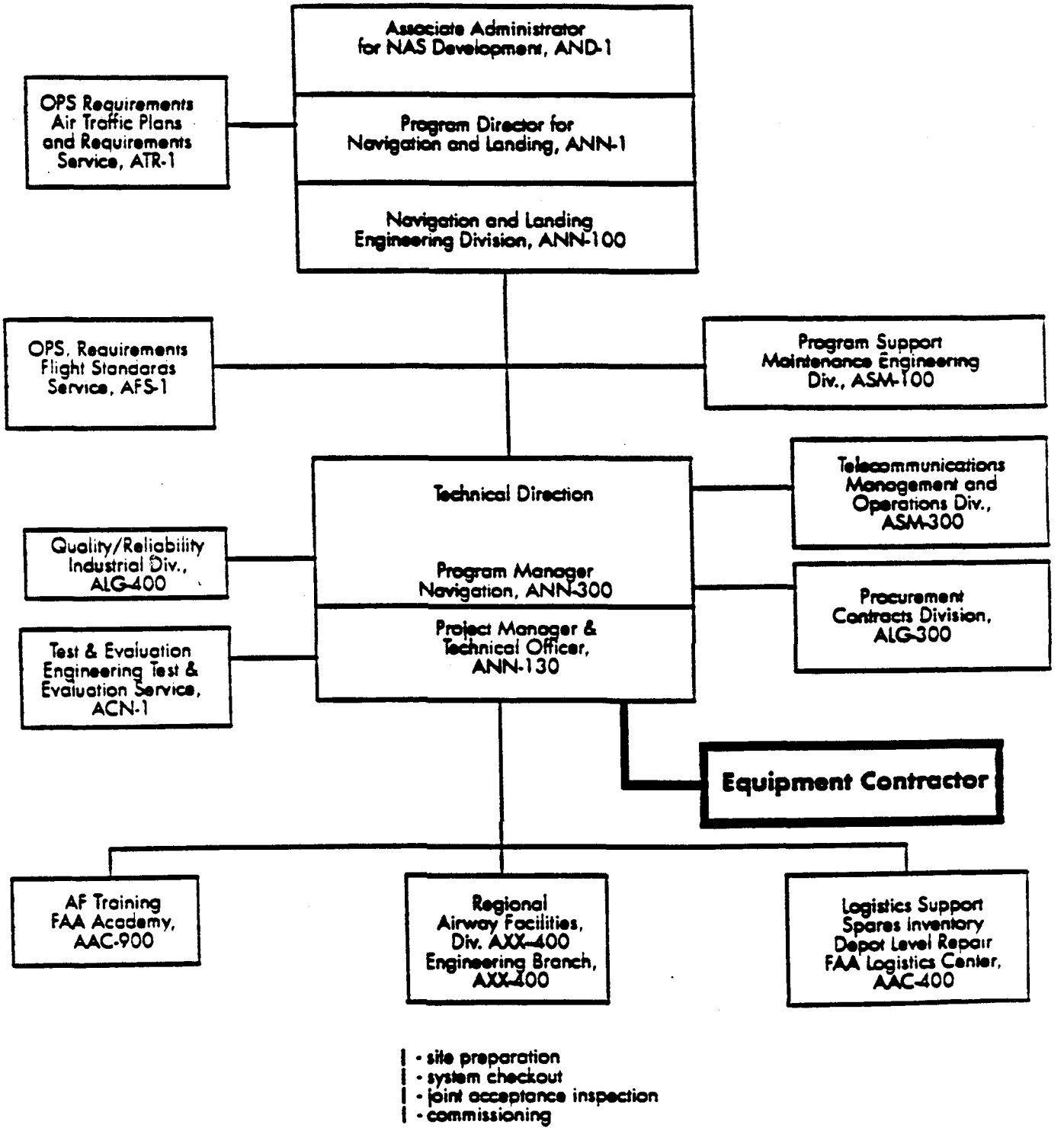
b. FAA-G-2100e, Specification, Electronic Equipment, General Requirements, March 11, 1987.

c. Order 6030.45, Facility Reference Data File, February 3, 1987.

d. Order 6820.10, VOR, VOR/DME, VORTAC Siting Criteria, April 17, 1986.

e. MIL-STD-461C, Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference, August 4, 1986.

FIGURE 5-1. PROJECT RESPONSIBILITY MATRIX



f. Remote Maintenance Monitoring System Interface Control Document, NAS-MD-790, June 10, 1986.

g. Operational Requirements for the Remote Maintenance Monitoring System, NAS-MD-792, October 3, 1988.

h. Functional Requirements for the Remote Maintenance Monitoring System, NAS-MD-793, February 28, 1988.

i. FAA-D-2494/b, Technical Instruction Book Manuscript: Electronic, Electrical and Mechanical Equipment, Requirements for Preparation of Manuscript and Production of Books, March 14, 1984.

j. Order 4800.2A, Utilization and Disposal of Excess and Surplus Personal Property, September 7, 1977.

k. FAA-C-1217c, Electrical Work, Interior, September 30, 1968.

l. EIA-RS-232-C, Industrial Standard, Interface Between Terminal Equipment and Data Communication Equipment Employing Serial Binary Data Interchange.

58.-59. RESERVED.

CHAPTER 6. PROJECT FUNDING

60. PROJECT FUNDING STATUS, GENERAL. Project funding for the VOR/DME program is a multiyear effort. The initial award for 40 systems used FY-89 funds and the first of three options for 10 systems was exercised at time of contract award to Wilcox Electric, Inc., using FY-90 funds. The remaining two options for 10 systems each will be exercised prior to July 1992 using FY-92 funds assuming that these funds will be approved by Congress for the FY-92 budget. The contract contains a provision which requires that the final option must be exercised within 2 years following the contract award.

61. REGIONAL FUNDING. The program funding includes those funds to be provided to the regional Airway Facilities divisions for site acquisition, construction, installation, electronic tune-up, and flight inspection costs, less the regional in-house labor costs.

62. ADDITIONAL FUNDING. Program funds are also provided for in-house engineering support and the costs associated with the first article installation and testing at the FAA Technical Center.

63.-69. RESERVED.

CHAPTER 7. DEPLOYMENT

70. GENERAL DEPLOYMENT ASPECTS. Deployment of the VOR/DME systems in accordance with the contract schedule requires that the first article system is to be shipped to the FAA Technical Center 22 months after contract award. Production delivery of six systems per month is scheduled to commence 26 months after contract award and to continue at that rate until all deliveries are complete. Delivery is specified to be F.O.B. destination to the site locations provided by the Government. Table 7-1 depicts the schedule for the DRR.

TABLE 7-1. DRR SCHEDULE

Initiate the DRR process	March 1991
Announce DRR Team Meeting	April 1991
Convene DRR Team Meeting	May 1991
Mid-Term Review	January 1992
Submit DRR Report	December 1992
DRR Excom Meeting	December 1992
Deployment Decision	January 1993

71. SITE PREPARATION. The regional Airway Facilities divisions are responsible for required site preparation. Site preparation includes, but is not limited to, acquisition, by the regional Logistics division, by lease or purchase of the land required for the physical plant installation, providing appropriate commercial AC power, arranging for the lease of an acceptable four-wire telephone service from the VOR/DME site to the controlling AFSS, construction of the VOR/DME equipment shelter, and access road preparation.

72. DELIVERY. The first VOR/DME system is scheduled to be delivered to the test and evaluation site at the FAA Technical Center, Atlantic City, New Jersey, in August 1992 which is 22 months after the contract award. Production delivery is to commence 26 months after contract award at the rate of six systems per month and is to continue at that rate until all items on the contract have been delivered. The site delivery locations are as shown in appendix 1.

73. INSTALLATION PLAN. The installation and tune-up of the VOR/DME systems will be accomplished by the regions in accordance

with the installation section of the equipment instruction book. Standard 21'X 21' pre-cast concrete shelter with an independent 33 foot diameter counterpoise will be provided from a Washington office indefinite delivery/open ended requirements contract. The shelters will be set in place and the counterpoise will be erected by the shelter manufacturer on foundations provided by the Government. The standard drawings required for the shelter and counterpoise construction activities will be issued by ANS-240. Any questions on the shelter or counterpoise should be addressed to that office.

74.-79. RESERVED.

CHAPTER 8. VERIFICATION

80. FACTORY VERIFICATION. The contractor will perform a series of Government approved tests in accordance with the requirements of the contract, the VOR/DME specification, FAA-G-2100, Electronic Equipment, General Requirements and other applicable documents prior to acceptance of the equipment by the FAA. The tests conducted will include design qualification, type, production, reliability, maintainability, and fail-safe tests that will demonstrate that all hardware, software, and all performance requirements are met before the FAA accepts a VOR/DME system from the contractor.

81. CHECKOUT. The first article VOR/DME system is to be shipped to the FAA Technical Center for installation and tune-up by the contractor in a Government furnished shelter using Government furnished VOR and DME antennas. This initial installation will be in a conventional VOR configuration. Following installation, tune-up and initial ground checks, the FAA will conduct a full commissioning type flight inspection. Of principal importance during the contractor conducted site acceptance testing is the interface of the VOR/DME RMS and the field support MPS at the FAA Technical Center and verification of the installation section of the equipment instruction book. During this testing, the VOR/DME system will be fully integrated with all internal and external interfaces including the remote status communication equipment (RSCE).

82. CONTRACTOR INTEGRATION TESTING. Following the checkout testing of paragraph 81, the FAA integration testing of paragraph 84 and the shakedown testing of paragraph 85, the contractor will convert the conventional VOR to the Doppler configuration and conduct checkout tests similar to those performed on the conventional system under paragraph 81.

83. CONTRACTOR ACCEPTANCE INSPECTION (CAI). The requirements to be satisfied for final acceptance will be covered in the contractor prepared MTP and will be completed during the checkout and contractor integration testing of paragraphs 81 and 82.

84. FAA INTEGRATION TESTING. The ACN-210 Test Director will prepare test plans and procedures for the FAA integration testing, and evaluation (IT&E) to be completed at the FAA Technical Center. The IT&E will verify the technical performance of the VOR/DME system in a full field environment and with an operational RSCE and the field support MPS at the FAA Technical Center. At this time, the IMCS will have been baselined and will be resident on the FAA Technical Center MPS. The capability of the VOR/DME to properly interface with the MPS is critical to the

overall operation and maintenance of the systems in the NAS. The operation and maintenance of the VOR/DME system during the IT&E testing is the responsibility of the FAA.

85. **SHAKEDOWN AND CHANGEOVER.** The FAA Technical Center ST&E is the responsibility of ASM-600 and will be conducted on the system installed at the FAA Technical Center. During system shakedown, tests are conducted to verify that the VOR/DME system, fully integrated in an operational environment, meets all operational requirements and is fully maintainable. System ST&E test activities will include accomplishment of the following:

a. Evaluation of the RMS diagnostic functions for effective system failure detection and acceptability of displayed operational data.

b. Verification of the instruction book procedures for routine and corrective maintenance.

c. Validation of the instruction book installation and tune-up procedures.

d. Verification of the system RMS functions from the remote control point using the maintenance data terminal (MDT) at the MPS.

86. **JOINT ACCEPTANCE INSPECTION (JAI).** A JAI will be completed prior to assumption of maintenance responsibility by the Airway Facilities Sector. The JAI, to be accomplished in accordance with Order 6030.45 will be completed following successful completion of the field shakedown test. The field shakedown test will be completed in accordance with the plans and procedures to be developed by ASM-600. The field shakedown test and the JAI, together, assure that the VOR/DME system complies with requirements in the following areas prior to final acceptance and commissioning.

a. Facility construction, equipment installation, and tune-up.

b. Facility/system/equipment performance including a successful flight inspection and reference ground check.

c. Facility technical performance documentation and maintenance reference data.

d. Facility logistics supports.

e. Facility/system training support.

f. Availability of acceptable system/equipment instruction books.

87.-89. **RESERVED.**

CHAPTER 9. INTEGRATED LOGISTICS SUPPORT

90. MAINTENANCE CONCEPT. The maintenance concept for the VOR/DME systems shall consist of both site and FAA Logistics Center repair. Maintenance technicians will replace failed LRU and may perform limited corrective and preventative maintenance repair functions, as required, onsite. The maintenance technicians will replace the faulty LRU and send the repairable LRU to the FAA Logistics Center for exchange and repair (E&R). The FAA Logistics Center will either repair the defective LRU in-house or have it repaired under an equipment repair support contract.

91. TRAINING. The initial training for the VOR/DME systems will be conducted by the equipment contractor in accordance with the training program option in the contract which was exercised at the time of contract award. The training program requires that the contractor conduct five classes, two of which involve system repair to the component level with the balance (three) providing training for repair to the LRU level. Regional office personnel from the seven receiving regions will be scheduled to attend the early LRU level classes together with technicians and engineers from the receiving sectors. An option for an additional five classes to be conducted by the contractor remains to be exercised, if required.

92. SUPPORT TOOLS AND TEST EQUIPMENT. The contractor shall identify all required special and common tools and test equipment including card extenders, jigs, fixtures, automated test equipment (ATE), and related software and material handling equipment required for performing preventative and corrective maintenance at any level. The contractor shall provide those items identified as unique to the VOR/DME system testing and repair requirements and the Government will provide the balance either onsite or at the work center or FAA Logistics Center, as appropriate.

93. SUPPLY SUPPORT. The FAA Logistics Center is responsible for providing supply support for the VOR/DME systems. The contractor will furnish spare parts peculiar, as identified during the provisioning process, to the FAA Logistics Center and will furnish site spare printed circuit boards and modules on the basis of one set of spares for each three systems under contract.

94. VENDOR DATA AND TECHNICAL MANUALS. Instruction books for the VOR/DME systems will be provided in accordance with Specification FAA-D-2494/b. The draft manuscript prepared by the contractor, is submitted to the FAA for review and approval. After FAA approval, the contractor submits a camera-ready copy to

the FAA for final printing of a quantity sufficient to provide two copies for each system plus a significant number for regional and Washington offices and for stock quantities at the FAA Logistics Center.

95. EQUIPMENT REMOVAL. Any surplus material removed during the installation of the VOR/DME systems shall be disposed of in accordance with Order 4800.2A, Utilization And Disposal Of Excess and Surplus Personal Property.

96. FACILITIES. Not applicable.

97.-99. RESERVED.

APPENDIX 1. VOR/DME DELIVERY LOCATIONS

Appendix 1

REGION		LOCATION	STATE	IDENT	SCHEDULE
1	AC	Oklahoma City	OK	AAC-440	NOV 92
2	AC	Oklahoma City	OK	AAC-940	NOV 92
3	AC	Oklahoma City	OK	ASM-600	NOV 92
4	SW	Bartlesville	OK	BVO	NOV 92
5	NM	Glen Elk (Denver)	CO	TBD	NOV 92
6	NM	Wiggins	CO	TBD	NOV 92
7	AL	Barter Island	AK	BTI	DEC 92
8	SW	Columbus	NM	CUS	DEC 92
9	SW	White Lake	LA	LLA	DEC 92
10	AL	Point Heiden	AK	PTH	DEC 92
11	GL	Kenosha	WI	ENW	DEC 92
12	SO	Georgetown	BH	MYGG	DEC 92
13	GL	Mount Pleasant	MI	MOP	JAN 93
14	WP	Mammoth Lakes	CA	MMH	JAN 93
15	NM	Badger Mountain	WA	WA1	JAN 93
16	SW	Marvel	AR	AR1	JAN 93
17	SO	San Salvador	BH	MYSM	JAN 93
18	GL	La Crosse	WI	LSE	JAN 93
19	WP	Payson	AZ	AZ2	FEB 93
20	NM	Chemult	OR	OR1	FEB 93
21	SW	Ozona	TX	TX2	FEB 93
22	CE	Ogallala	NE	OGA	FEB 93
23	GL	Springfield	OH	SGH	FEB 93
24	NM	Omak	WA	OO4	FEB 93
25	SW	Uvalde	TX	TX1	MAR 93
26	CE	Broken Bow	NE	CUZ	MAR 93
27	GL	Burlington	WI	OO7	MAR 93
28	NM	Glendive	MT	MT1	MAR 93
29	SW	Cypress	LA	TBD	MAR 93
30	GL	Kankakee	IL	IKK	MAR 93
31	SW	Stamford	TX	TX3	APR 93
32	NM	Mg. Reservoir (Hailey)	ID	OO3	APR 93
33	SW	Cocos	LA	KA1	APR 93
34	SO	Destin/Walton (Eglin)	FL	TBD	APR 93
35	NM	Sand Springs	MT	MT2	APR 93
36	CE	Concordia	KS	CJP	APR 93
37	GL	Racine	WI	HRK	MAY 93
38	NM	Whidbey Island	WA	NUW	MAY 93
39	NM	Brigham City	UT	OO2	MAY 93
40	WP	Inyokern	CA	IYK	MAY 93
41	GL	Baudette	MN	BDE	MAY 93
42	CE	Marshalltown	IA	MIW	MAY 93
43	GL	Ely	MN	ELO	JUN 93
44	CE	Gordon	NE	CQT	JUN 93
45	GL	Gaylord	MI	GLR	JUN 93

APPENDIX 1. VOR/DME DELIVERY LOCATIONS

Appendix 1

REGION		LOCATION	STATE	IDENT	SCHEDULE
46	CE	Muscatine	IA	RTY	JUN 93
47	GL	Hillview	IL	IL4	JUN 93
48	GL	Manistique	MI	ISQ	JUN 93
49	SO	Great Inagua	BH	MYIG	JUL 93
50	CE	Braymer	MO	BQS	JUL 93
51	GL	Evansville	IL	51S	JUL 93
52	GL	Buffalo	SD	BUA	JUL 93
53	WP	Gila Bend	AZ	GBN	JUL 93
54	CE	West Plains	MO	HUW	JUL 93
55	SW	East Bernard	TX	OO1	AUG 93
56	SO	Sinca	GA	TBD	AUG 93
57	GL	Roseau	MN	ROX	AUG 93
58	WP	Quail Mesa	AZ	2L3	AUG 93
59	CE	Thedford	NE	TDD	AUG 93
60	SO	Shine	NC	XXX	AUG 93
61	WP	Prescott	AZ	PRC	SEP 93
62	CE	Orleans	NE	VOS	SEP 93
63	GL	Cleveland	OH	CLE	SEP 93
64	SO	Selma	AL	CAQ	SEP 93
65	SW	Austin	TX	AUS1	SEP 93
66	SW	Austin	TX	AUS2	SEP 93
67	AC	FAA Logistics Center			OCT 93
68	AC	FAA Logistics Center			OCT 93
69	AC	FAA Logistics Center			OCT 93
70	AC	FAA Logistics Center			OCT 93